Holcim (Romania) SA

JI - Project for reduction of CO_2 emissions at Aleşd Cement Plant and Campulung Cement Plant

Baseline Study

July, 2002

Content

1 PROJECT INFORMATION

1.1. Project characteristics

Supplier's name and address:

Company name: **Holcim (Romania) SA**

Address: Bdul Primaverii 57, sector 1, Bucharest, Romania

Zip code + city address: 71297, Bucharest

Postal address: Bdul Primaverii 57, sector 1, Bucharest, Romania

Zip code + city postal address: 71297, Bucharest

Country: Romania

Contact person: Kurt Habersatter

Job title: CEO

Telephone number: ++40 21 231.77.08

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E-mail address: kurt.habersatter@holcim.com

Date of registration: 23 January 2002

1.1. A. Local contact – Alesd Cement Plant

Company name: **Holcim (Romania) SA – worksite : Ciment Alesd**

Address: Viitorului 2

Zip code + city address: Comuna Aştileu, Sat Chistag, Bihor County

Postal address: Comuna Aştileu, Sat Chistag, Bihor County

Zip code + city postal address: -

Country: Romania

Contact person: Javier Ocenda

Job title: Plant Manager

Telephone number: ++40 (0) 259 34 97 65

Fax number: ++40 (0) 259 34 97 72

E-mail address: Javier.Ocenda@holcim.com

1.1.B. Local contact – Campulung Cement Plant

Company name: **Holcim (Romania) SA – worksite: Ciment Campulung**

Address: Calea Brasovului 1

Zip code + city address: RO-0425 Campulung Muscel

Postal address: Calea Brasovului 1

Zip code + city postal address: RO-0425 Campulung Muscel

Country: Romania

Contact person: Emil Raicov

Job title: Plant Manager

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1.2. Project Abstract

1.2. A. Alesd Cement Plant

- **Project Title**: Upgrading Alesd II Cement Plant
- **Abstract**: the project consist of upgrading of an existing 3000 t clinker/day kiln line. An important goal of this project is the replacement of the old installations with new ones, that will eliminate the negative impact on environment and will allow the production of cement with less thermal and electrical energy.
- **Project location**: Holcim (Romania) SA, Ciment Alesd plant, Village Astileu, Bihor county
- **Project starting date**: 2000
- **Construction starting date**: 2001
- **Construction finishing date**: 2004 (priority 1 subprojects)
- **Project finishing date:** 2006 (priority 2 subprojects)

1.2. B. Campulung Cement Plant

- **Project Title**: Refurbishing Campulung Cement plant
- **Abstract**: The project consist of upgrading the existing 2x800 t clinker/day kiln lines, 1 and 3. An important goal of this project is the replacement of the old installations with new ones, but also installation of new equipments, that will allow a more ecologically friendly production of cement, with less thermal and electrical energy consumption.
- **Project location**: Holcim (Romania) SA,Ciment Campulung plant, Campulung, Arges county
- **Project starting date**: 2000
- **Construction starting date**: 2001
- **Construction finishing date**: 2003

Project finishing date: 2004

1.3. Background and justification

Holcim (Romania) SA is the Romanian subsidiary of Holcim (formerly "Holderbank") Group, one of the world's leading suppliers of cement, ready-mixed concrete, as well as aggregates (gravel and sand), and constructions related services.

From origins in Switzerland, the Group has grown into a global player with strong market presence in over 70 countries on all continents.

In its new markets development process, Holcim Group acquired in Romania three cement plants as follows:

- Turda cement plant: June 1997 - a wet process cement plant, that apart from its grey cement production, it is the only WHITE CEMENT manufacturer in the country.
- Campulung cement plant: October 1999 – dry process cement plant producing grey cement
- Alesd cement plant: July 2000 – dry process cement plant producing grey cement

At the end of 2001 the group merged all its activities in Romania under one name : Holcim (Romania) SA.

The cement manufacturing process may be split on the following technological stages:

- raw material extraction and preparation
- raw meal preparation
- raw meal burning in kiln in order to produce clinker = clinker production
- clinker grinding and mineral components (MIC) addition in order to produce the cement = cement production
- cement dispatch (shipping)

Every technological stage was carefully analyzed by Holcim specialists since the acquisition and a large number of projects of different size and importance were defined in order to the efficiency of the cement manufacturing process and in the same time the environmental protection.

1.3.A. Alesd Cement Plant

The plant from Alesd was developed in two stages: Alesd I with 6 x 800 t clinker/day kilns (commissioned in early 1970) and later Alesd II with 1x 3000 t clinker/day (commissioned in 1983).

The kiln line of Alesd II that is to be upgraded is a dry process one, with equipments corresponding to the technological level of the ‘70s, manufactured mainly in Romania.

Due to the low demand of the market, the kiln was decommissioned in 1991 and from than it was not used for clinker production.

Currently, at Alesd plant there are used only 2 older kilns with a rate of 800 t clinker/day to produce the clinker (Alesd I), which then is grounded in the cement mill of Alesd II.

Due to their age, some of the equipment of these kilns is obsolete and it doesn’t assure the cement production in an efficient and ecologically friendly way.

Therefore, since the beginning, lots of projects of different size and importance were defined for Alesd. Due to the fact that the total cost of those projects is over 54 million EUR, their priority was set based on necessity and according to the budget restriction.

Top priority was given to the projects that:

- could assure the functionality and productivity improvement of the currently commissioned kiln lines (Alesd I): general refurbishment, purchasing of new front end loaders and drilling machines for quarry area, improvements in the the raw material extraction and preparation area, feeding arrangements for clinker, improvements of the basic infrastructure (roads, railway lines) etc
- could drastically decrease the production costs: installation of new (cheaper) fuels (coal) feeding systems
- could improve the product quality: laboratory equipment, raw materials analyzer
- could assure social and safety improvements: fence and lights, refurbish canteen and administrative building, guest house etc

Due to their priority, those projects were started and are already partially or totally finished.

1.3.B. Campulung Cement Plant

The cement plant from Campulung was founded in 1971.

It is a dry process cement producing plant and has an operating clinker capacity of 3x800 t clinker/day.

The equipment of the kiln lines from Campulung are corresponding to the technological level of the ‘60s, manufactured mainly in Romania.

Due to their age, some of the equipment of these kilns is obsolete and it doesn't assure the cement production in an efficient and ecologically friendly way.

Since the acquisition, a large number of projects were defined especially for two kiln lines (1 and 3): restoration of refractory for kilns and preheater towers, installation of splash boxes, installation of dedusting equipments and improvements of existing ones, installation of new low NOx kiln burners, installation of automatic continuously monitoring systems for process and for emissions, installation of new (cheaper) fuels feeding systems, upgrading of the cement mill # 5, introducing new types of mineral components (MIC) and installation of their handling, dosing, feeding systems, developing new products and decreasing the clinker factor, etc. Due to the fact that the total cost of those projects is over 30 million EUR, their priority was set based on necessity and according to the budget restriction.

Top priority was given to the projects which:

- could be done during the yearly overhaul (restoration of refractory for kilns and preheater towers, installation of splash boxes) by the local maintenance team.
- could decrease the emissions and assure the compliance with applicable environmental regulation: installation of dedusting equipments and improvements of existing ones, installation of new low NOx kiln burners, installation of automatic continuously monitoring systems for process and for emissions
- could drastically decrease the production costs: installation of new (cheaper) fuels (coal)feeding systems

Due to their priority, those projects were started and are already partially or totally finished.

1.3.C. Justification

The CO_2 emissions in the cement industry can be tackled by different measures.
The main categories of CO_2 abatement potentials include:

- energy efficiency: technical and operational measures to reduce fuel and power consumption per unit clinker or cement produced;
- fuel switching: for instance, use of natural gas or AFR (alternative fuels derived from wastes) instead of coal;
- reduction of dust landfilling (cement kiln dust, bypass dust), where relevant landfilling occurs;
- MIC: use of mineral components to substitute clinker.

The aim of Holcim (Romania) SA participation as Supplier of ERUs for the Dutch Government within ERUPT program is to bring financial incentive for **a portfolio of two projects**:

a) A project that will put again into operation the whole Alesd II line (also recommisioning the 3000 tones of clinker/day kiln) and shut down the 800 t clinker/day kilns from Alesd I.

For ERUPT purposes, the project will be further called "**Project: Upgrading Alesd II cement plant**" and will consist mainly in the next tasks:

- upgrading of raw mill feed system and of raw mill grinding (including variable speed drivers for fans and dedusting)
- upgrading the preheater tower (reconditioning) and of its fans
- upgrading the 3000 tones of clinker/day kiln (Low Nox burner, refractory material, inlet and outlet seals, kilns driver – variable speed drivers, etc)
- upgrading the cooler (reconditioning, variable speed drivers, de-dusting)
- introducing in the cement producing process new types of mineral components and installation of their handling, dosing, feeding systems into the cement mill,
- upgrading of the cement mill in order to increase its energy efficiency
- developing new products and decreasing the clinker factor.

b) A project that, for ERUPT purposes, will be further on called **"Project: Refurbishment of Campulung Cement Plant"**, and will consist mainly in the next tasks:

- introducing in the cement producing process new types of mineral components and installation of their handling, dosing, feeding systems into the cement mill,
- upgrading of the cement mill #5, in order to increase its energy efficiency
- developing new products and decreasing the clinker factor.

The reasons that have led to the study of the possibility of these projects are:

- The market policy of the company
- The more efficient way to operate the production line
- The tighter control of the process
- Company commitment for sustainable development

The upgraded cement production lines will be more **energy efficient** due to the less thermal and electrical energy consumption during the cement production resulted from the newly upgraded installations. At the same time they will allow the introduction (unloading, storage, handling and dosing) of a **new type of MIC** and the production of new types of cement for the Romanian market. The re-commissioned line from Alesd can be considered "state of the art" for Romanian cement industry from efficiency point of view.

Therefore, the ERUs, offered as carbon credits by Holcim (Romania) SA for the Dutch Government within ERUPT program, are the **emission reductions due to energy efficiency improvements**. Changes in the fuel mix will not be included as CO_2 emission reductions. In case a different fuel mix will be used, the emissions will be corrected as if the fuel mix described in this baseline report was used, in order to avoid CO_2 credits that would be caused by switching to coal before the project and (partly) switching back to other type of fuels during the projects period.

Both projects are feasible, but not very attractive from the economically point of view.

They are not an absolute necessity for the cement production in Alesd and Campulung plants.

The re-commissioning of 3000 tones of clinker/day kiln and the simultaneous increase in production capacity is not done in order to fulfill the short and medium term increase of the market demand, currently Romania has an excess capacity (at 2000 year level only 50.9% of the total installed capacity was used)[1].

Also, the development of the new and higher quality types of cement (already available in EU) is not a requirement of the current or near future Romanian cement market.

Therefore, the improved facilities will not be needed to meet the demand of cement in short or medium term, but there would especially have a positive impact on the environment both by reducing the Greenhouse Gases (CO_2) emissions and by using the waste of other industries (as clinker substituting mineral components –MIC), otherwise land-filled as it is in the present.

The plants' project teams, supported by Holcim Group engineering and consulting services from Switzerland are coordinating the site preparation works, including obsolete equipment demolition and removing scrap, tenders for detailed engineering, local and foreign equipment suppliers and erection companies and project management.

The total cost of the projects has been estimated at about 30 million EUR (21 million EUR – priority 1 subprojects, 9 million EUR priority 2 subprojects) for Alesd Cement Plant and at about 5 million EUR for Campulung cement plant

The main part of this cost will be covered by Holcim (Romania) SA, with financial support from the mother company.

1.4. Intervention

1.4.1. Goals

- Stronger competitiveness on the cement market
- Decreasing the overall power consumption;
- Decreasing the heat consumption;
- Producing a cement with higher quality;
- Reducing the overall production costs;

1.4.2. Results

Developing a cost-effective and more environmentally friendly production capacity, that will allow the manufacturing of various cement types, with less energy consumption and with a lower clinker factor, therefore assuring a stronger competitiveness of the company on the specific market.

1.4.3. Activities

Due to the fact that the main expected output from for a JI project is the reduction of Greenhouse gases emissions, in this section only the activities with a direct impact over the factors that influence these emissions are mentioned

[1] Source: Romanian Industries and Resources Ministry - Construction Materials Development Strategy on medium and long term 2001-2010

1.4.3. A. Alesd Cement Plant

a) Reducing specific energy consumption

- installation of 2 bucket elevator instead of the existing 2 air lifts, that will reduce the specific energy consumption from 1.14 kWh/t/100 m to 0.41 kWh/t/100 m.
- installation of a 1050 kW variable speed drive for the kiln/raw mill fan
- installation of a high efficiency dynamic separator for raw mill
- installation of a new low NOx burner for kiln
- installation of 2x560 kW variable speed drives for kiln
- installation of 1x500 kW variable speed drive for cooler dedusting
- installation of a cycloconverter for raw mill drive in a first stage (until 2003) and for the cement mill drive in the second stage
- installation of high efficiency separator for cement mill (second stage)

These modifications will allow a specific energy consumption of:

110 kWh/t cement (first stage) and **105 kWh/t cement (second stage)**
(for a clinker factor of 0.70)

instead of 144.71 kWh/t cement (for a clinker factor of 0.78).

b) Reducing specific heat consumption

- repairing the entire preheater, restoration of refractoriess
- new refractories for kiln
- repair of kiln inlet and outlet seals
- new design of cooler that will reduce the necessary of the aeration air
- installation of a fixed inlet skid in the cooler

These modifications will allow a specific heat consumption of:

3600 kJ/kg clinker

instead of 4033 kJ/kg clinker

c) Reducing specific CO2 emissions

In the final product - cement, the amount of clinker is to be reduced from 78% to 70% and mineral components percentage is to be increased

1.4.3. B. Campulung Cement Plant

a) Reducing specific energy consumption

Ugrading of cement mill #5 by:

- installation of new gear box for the cement mill #5
- installation of a high efficiency separator for cement mill #5 with variable speed drive
- installation of a separator fan with variable speed for cement mill #5

These modifications will allow a specific energy consumption of:

120 kWh/t cement (for a clinker factor of 0.70)

instead of 132.4 kWh/t cement (for a clinker factor of 0.76).

In order to maintain the same specific energy consumption, similar improvements will be also done at the mill #3, as part of this project, when the cement mill #5 capacity will be overcome by the production volume.

- related installations: new material feeding equipment (new weighfeeders, conveyors, modification of existing concrete feed bins)
- new mineral components unloading, storage, handling and dosing systems

b) Reducing specific CO2 emissions

- in the final product, cement, the amount of clinker is to be reduced from 76% to 70% and mineral components percentage is to be increased

2 GHG SOURCES AND SINKS AND PROJECT BOUNDARIES

2.1. Greenhouse gases sources

One of the key issues for being able to claim carbon credits from a project is that the reduction of emissions has to be additional to any that would have occurred in the absence of the project activity. This section will focus on the environmental or greenhouse gases reduction additionality of the project.

There will be mainly two emission types involved: Direct On-Site Emissions and Direct Off – Site emissions.

In the case of cement industry CO_2 is the only considered greenhouse gas[2], the other occur in insignificant volumes (much below 1%) and therefore they will not be taken into consideration for both baseline and project emission calculations.

2.1.1. Direct on-site emissions

- **CO2 from raw material calcinations**

The raw material for clinker production is a mixture of limestone and marl/clay. The raw materials have in their structure mainly calcium carbonate and magnesium carbonate, for which at 900-1000 Celsius degree a process of calcinations occurs, resulting CO_2 and a mixture of calcium and magnesium oxides:

$$CaCO_3 + heat \rightarrow CaO + CO_2$$

$$Mg\ CO_3 + heat \rightarrow MgO + CO_2$$

Further on with the temperature increase, from this mixture of oxides the clinker is formed, at around 1450 Celsius degree.

When considering CO_2 emissions due to calcinations, two components can be distinguished:

[2] Source “The Cement CO_2 Protocol” for the Cement Industry – developed by World Business Council for Sustainable Development (WBCSD) Working Group Cement

- CO_2 from actual clinker production
- CO_2 from raw materials discarded (landfilled) as partly calcined cement kiln dust (CKD), or as fully calcined bypass dust

CO_2 from actual clinker production is proportional to the lime (calcium oxide) and magnesium oxide content of the clinker, which in turn varies very little in time or between different cement plants.

According to "The Cement CO_2 Protocol" a default factor of 525 kg CO_2 /t clinker should be used for the calculation of CO_2 released during the calcinations process. This is the IPCC default (510Kg CO_2/t clinker) corrected with the Mg CO_3 calcination

Due to the fact that the kiln dust, in both Alesd and Campulung cement plants, was/is and will be reintroduced into the process and not landfilled, it is not an applicable source of CO_2 emission in these plants cases.

Therefore, only the CO_2 emissions from actual clinker production will be analyzed for both baseline and project situation.

- **CO2 from kiln fuels**

The cement industry traditionally uses various fossil fuels (conventional fuels) to operate the kilns, including coal, petroleum coke (petcoke), fuel oil and natural gas.

In recent years, fuels derived from waste materials have become important substitutes of the fossil fuels around the world. These alternative fuels and raw materials (AFR) include fossil fuel-derived fractions such as e.g. waste oil and tires, as well as biomass-derived fractions such as waste wood and dried sludges from wastewater treatment.

The types of fuels usage depends mainly of their market price (their cost typically accounting for 30-40% of the cement production costs) and availability. In 1995 the most common used fuels were petcoke (39%), coal (42% - including lignite), followed by different types of waste (10%), fuel oil (7%) and gas (2%) [3].

The burning of both conventional and alternative fuels, in order to obtain the necessary heat for the clinker production process, results in CO_2 emissions through the kiln stack.

The use of alternative fuels is not feasible and it is not expected to become feasible in the short and medium term in Romania and therefore only the burning of the fossil fuels will be taken in consideration for both baselines and projects.

Due to the fact that the market price of the fuels has a strong impact on the percentage of their usage in order to reduce the unpredictable risks of this JI projects portfolio, the same usage assumptions will be used for baselines and corresponding projects emission calculations, but also for monitoring and reporting of the emission reduction resulted from the projects for ERUPT purposes. In case a different fuel mix will be used during the projects period, the emission calculations will be corrected by using the same mix usage as in the baselines.

Replacing more clinker by mineral components - MIC (decreasing the clinker factor), one will allow to save more clinker per tone of cement produced. Mineral components (MIC) are natural and artificial materials with latent hydraulic properties. Examples of MIC include gypsum and natural pozzolanas, blast furnace slag, and fly ash. MIC are added to clinker to produce blended cement. MIC use leads to an equivalent reduction of direct CO_2 emissions

[3] Source: European Commission – "Integrated Pollution Prevention and Control - Reference Document on Best Available Techniques in the Cement and Lime Manufacturing Industry"

associated with clinker production, both from calcination and fuel combustion. Artificial MIC are waste materials from other production processes such as, e.g. steel and coal-fired power production. Related GHG emissions are monitored and reported by the corresponding industry sector. Utilization of these MIC's for clinker substitution does not entail additional GHG emissions at the production site. As a consequence, indirect emissions have not be included in the cement production inventory.

2.1.2. Direct off-site emissions

Cement production is associated also with electrical energy consumption and therefore the power generation CO_2 emission effect (direct off-site) should be taken into consideration for both baselines and projects (electricity conservation projects)

2.1.3. Indirect on-site emissions

Emissions produced by the transport by road/rail of fuels, raw materials (including MIC) and cement are not considered for both baseline and project emission calculation, due to the relative insignificance and uncertainty of the emission quantification process.

2.1.4. Indirect Off - Side emissions

Emissions due to shifts in demand and/or supply of electricity and in demand and/or supply of different types of fuels will not be taken into account in the quantification of emissions, as they are difficult to measure and are not within the control of the project developer.

2.2. Project boundaries

2.2.A. Alesd cement Plant

Fig 1. shows a flow chart of the project **Upgrading Alesd II cement plant,** with its main components and connection. On this flow chart it has been marked with yellow the points where upgrading activities lead to a reduction of the CO2 emissions, directly or indirectly. Their description is presented at the chapter 1.Project information, Subchapter "Intervention".

The physical boundaries of the project including all the upgrading activities are shown in the flow chart below with red dotted line.

Going one step upstream one should include in the boundaries also the raw material extraction and preparation process.

Going one step downstream the cement shipping should be include in the project boundaries.

Therefore the new boundaries of the project are marked with blue dotted line in the bellow flowchart. This new boundaries for the project include only the significant (above 1%) CO2 emission sources, that can be controlled by the project developer (all the cement production line).

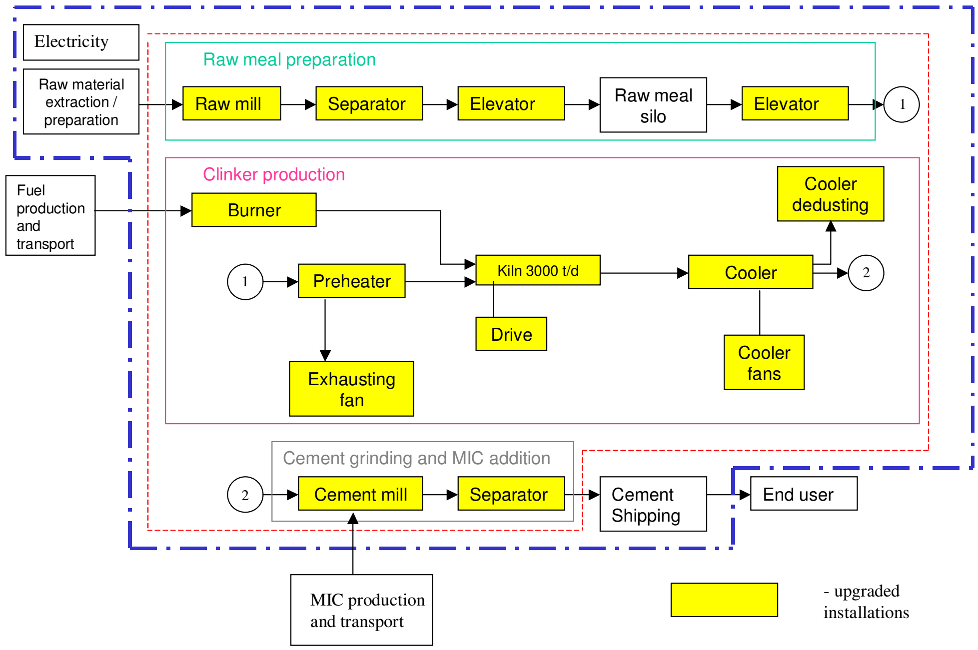


Fig. 1. Flow chart of the project **Upgrading Alesd II cement plant** and its borders

2.2.B. Camplung cement plant

Fig 2. shows a flow chart of the project **Refurbishment of Campulung Cement Plant** with its main components and connection.

On this flow chart it has been marked with yellow the points where upgrading activities lead to a reduction of the CO2 emissions, directly or indirectly. Their description is presented at the chapter 1.Project information, Subchapter "Intervention".

So the physical boundaries of the project, shown in the flow chart below with red dotted line, are set around the cement mill and its related installation (clinker grinding and mineral components (MIC) addition in order to produce the cement).

Going one step upstream one should include in the boundaries also the clinker production

Going one step downstream the cement shipping. should be include in the project boundaries.

Therefore the new project boundaries are marked with blue dotted line in the flow chart bellow.

This new boundaries for the project include only the significant (above 1%) CO2 emission sources, that can be controlled by the project developer (all the cement production line).

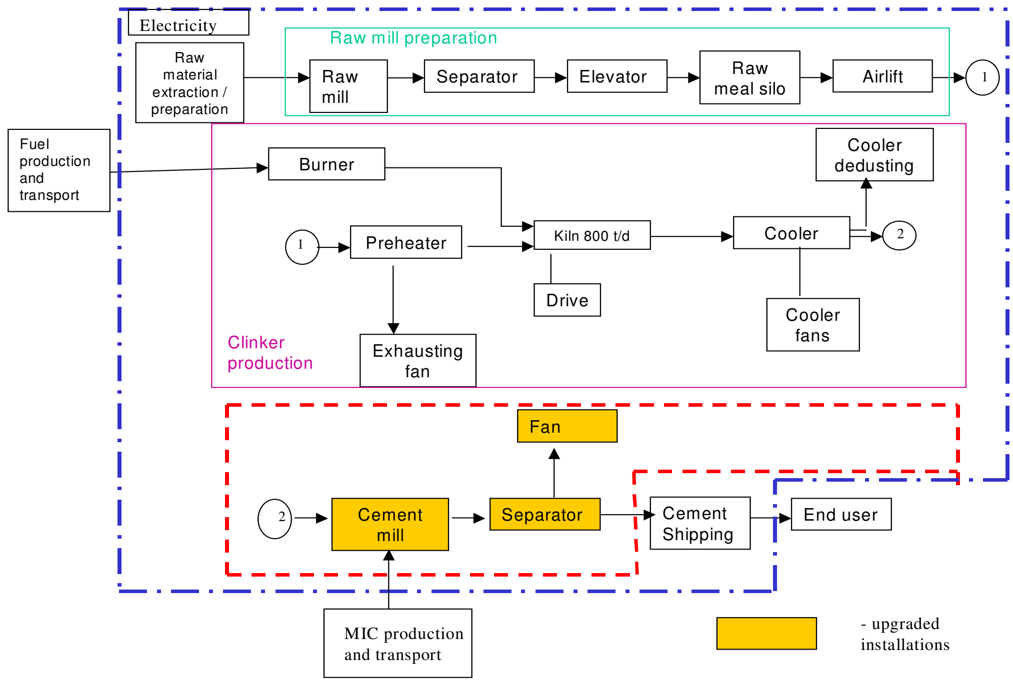


Fig 2. Flow chart of the project **Refurbishment of Campulung Cement Plant** and its borders

3 DESCRIPTION OF THE CURRENT DELIVERY SYSTEM

3.A. Alesd Cement plant

Fig. 3 shows the flowchart of the current delivery system (plant Alesd 1) which is basically the same with the upgraded one (it has the same technological stages and main equipment).

The differences consist in the type of equipment that replaces the old one.

The existing critical points are:

- static separator
- airlifts
- burner
- kilns
- kiln exhauster fan
- cooler
- No new MIC unloading, storage, handling and dosing systems

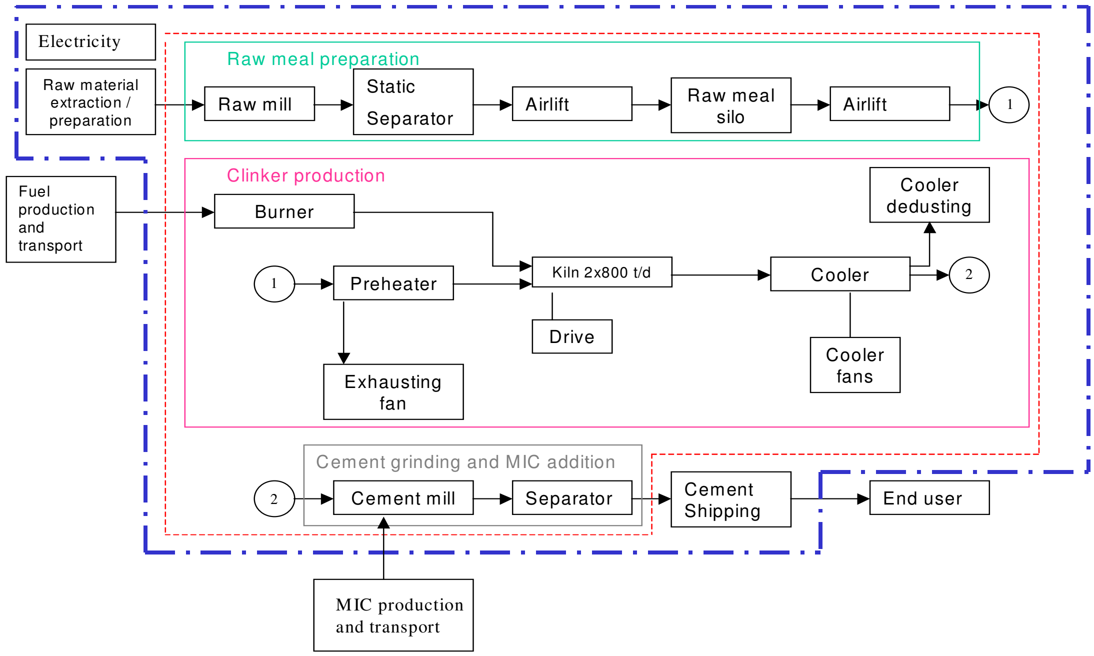


Fig.3. Flowchart of the current delivery system of Alesd cement Plant

The system is designed for continuous operation (24/24), with stop during the winter period (December – February) for maintenance.

3.B. Campulung Cement plant

The flowchart from Fig 4. represents the flowchart of the of the current delivery system in case of Campulung cement plant, which is basically is the same as the upgraded one (it has the same technological stages and main equipment).

The differences consist in the type of equipment that replaces the old one.

The existing critical points are related to the cement mills and their connected installations:

- Old gear boxes
- Old cement mill separators with low efficiency
- Old cement separator fans
- Old, obsolete and not accurate mill feeding systems
- No new MIC unloading, storage, handling and dosing systems

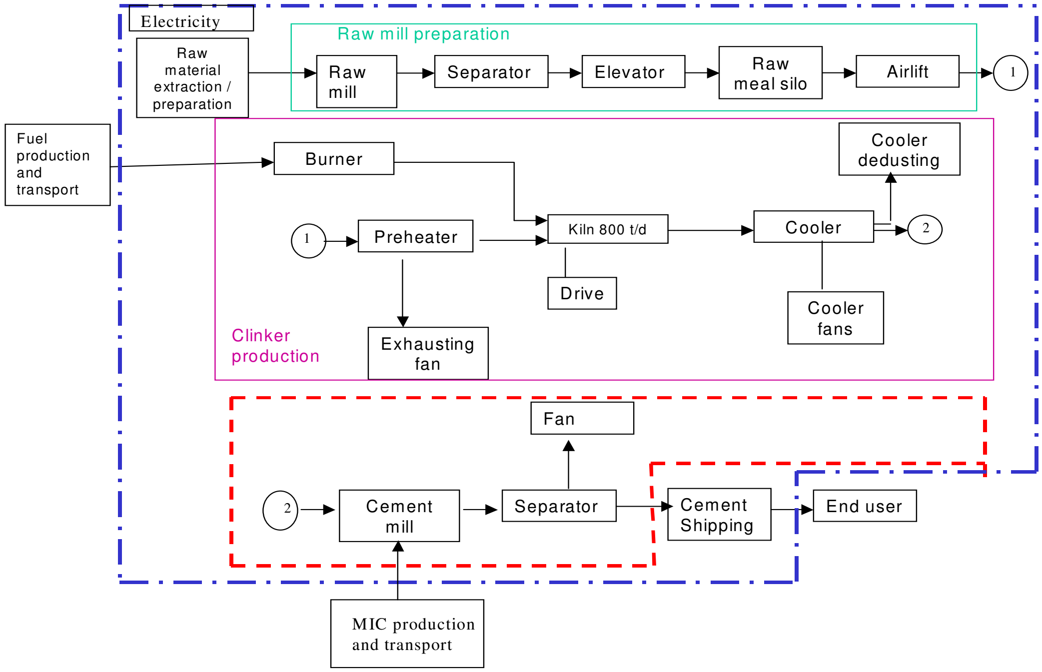


Fig.4. Flowchart of the current delivery system of Campulung Cement Plant

The system is designed for continuous operation (24/24), with stop during the winter period (December – February) for maintenance.

4 KEY FACTORS INFLUENCING THE BASELINE AND THE PROJECT

Economic Factors

Cement market evolution influences cement sales volume, which in turn influences directly the **volume of cement production**.

In the past years Romania suffered an important recession, with a growth rate of -15% on the period '96-'99 that ended in the year 2000 when the growth rate was +1.1%. Due to the country willingness to join EU, significant efforts were, are and will be done in order to ensure the economic development. The results of these efforts started to be seen and there are positive signs that the economic development continues in the same direction, the year 2001 showing a growth rate of 5.3% in the GDP[4].

The same development it can be noticed in all the Eastern European countries, candidates for joining EU.

For the cement industry, mainly due to the developments of infrastructure, residential but also non residential buildings, the GDP per capita positive development can be translated into a positive development of the cement consumption per capita, therefore Eastern Euro-

[4] Source: BNRO (Romanian National Bank), Romanian National Institute of Statistics

pean Countries presenting a high potential for cement consumption increase, as it is shown by figure 5[5].

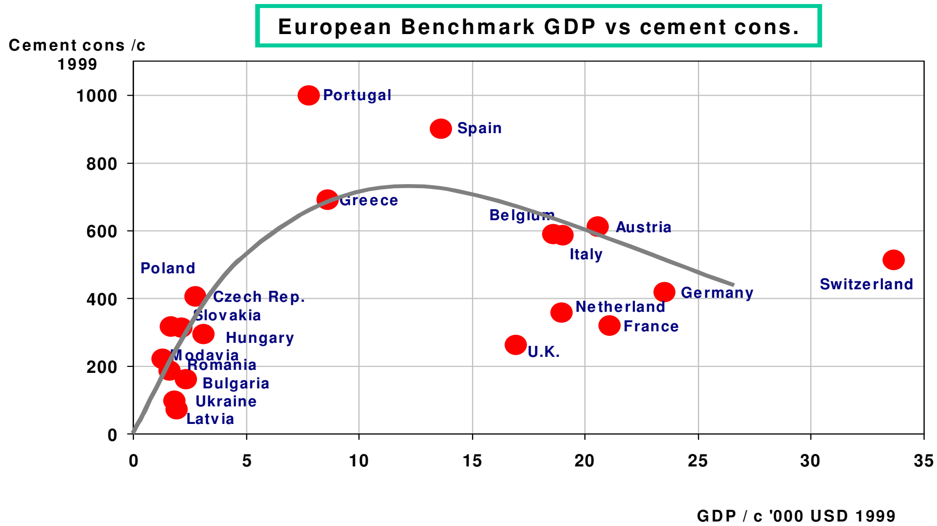


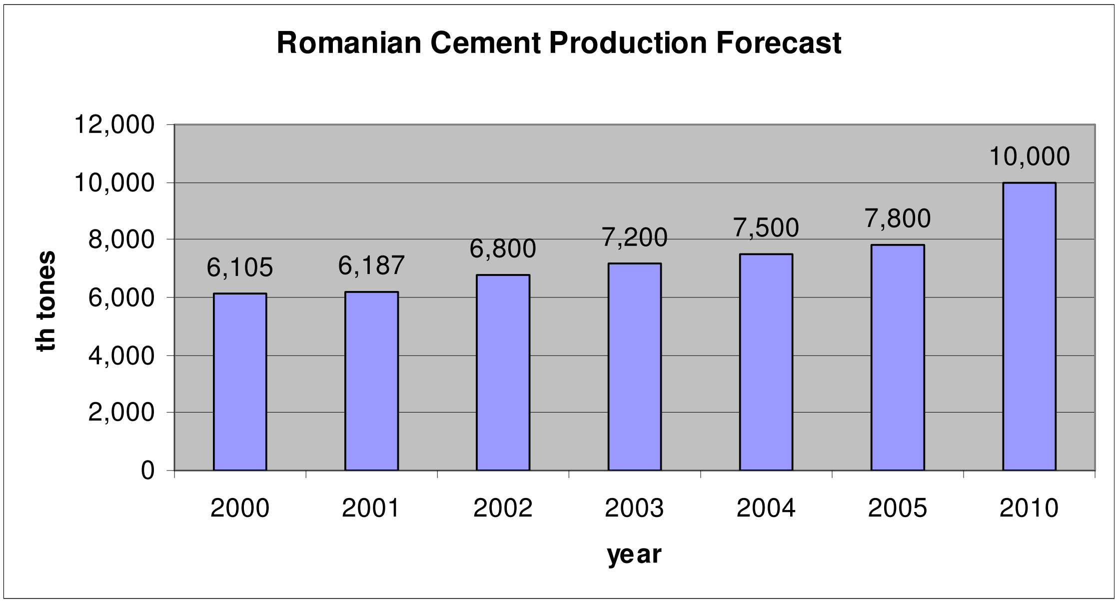
Fig 5. GDP per capita versus cement consumption per capita

The cement consumption in Romania is following the same specific trend of emerging economy, similarly with the other Eastern European Countries, having a direct relationship with the GDP per capita and with the real GDP growth, as it can be seen from the next table:[6]

000 t	1996	1997	1998	1999	2000	2001
Total Population (000 inh)	22,610	22,550	22,500	22,460	22,420	22,370
Annual Growth Rate of Population (%)	-0.31	-0.27	-0.22	-0.18	-0.18	-0.22
GDP (bil. EUR)	43.103	40.129	37.962	36.747	37.151	39.120
GDP per capita (EUR)	1906	1780	1687	1636	1657	1749
Real GDP Growth (%)	3.90%	-6.90%	-5.40%	-3.20%	1.10%	5.30%
Average Exchange rate ROL/EUR (000)	3.863	8.091	9.989	16.296	19.956	26.027
Total Cement Domestic Sales (all competitors)	4,089	3,527	3,588	3,821	4,205	4,297

The same positive trend, but with even stepper rate of 4% was also forecasted in 2000 for the medium to long term increase in sales and production of cement [7].

[5] Source: World Cement Review, Work Group calculation – in USD 1999
[6] Source: CIROM (cement industry owners'association) and Romanian National Institute of Statistics
[7] Source: Construction Materials Development Strategy on middle and long term (2001-2010) - Industry and Resources Ministry



The actual increase of the cement market is even higher than the forecasted one, both by authorities (4%) and by Holcim (Romania) SA in its Business Plan (3.5%), the actual sales volume for the 2002 year to date showing an increase of 7.2% compared with the volume for 2001 similar period of time [8].

The **fuel market price** it has an important influence over the cement industry. the orientation toward cheaper forms of energy.

Taking into account the increases in prices of oil and natural gas, both at national and international level (see Annex A), there is a strong orientation of the Romanian cement industry toward cheaper fuels with different **fuel specific CO2 emission** (coal/ petcoke), in order to reduce the production costs. Romania still has a sizeable amount of coal reserves, which may be used more competitively as a fuel source compared with fuel oil and natural gas.

The usage of cheaper fuels is already a common practice for the Romanian Cement Industry. There are four main players in this market: Lafarge – Romcim (3 plants), Holcim (Romania) (3 plants), Carpatcement (Heidelberger group) (2 plants) and Tagrimpex Romcif - Fieni plant (Romanian majoritary capital), out of which 3 are also well known players in the international cement market.

Therefore there is a very strong competition on the Romanian cement market. Due to the fact that the fuel cost is strongly influencing the production cost of the cement (over 30% of the cost is due to the fuel cost) and the coal price is approximately half of the heavy oil price, a 10-15 % decrease of total production cost is essential in the fight for the market.

Since Holcim (Romania)'s competitors either already use coal / petcoke as fuel (Lafarge in 2 plants and Tagrimpex Fieni) or have also projects in order to use them in the near future (Heidelberg in both plants), in order not to get an important competitive disadvantage, it has been already decided at the company level the switching for coal as main fuel in Campulung and Alesd.

[8] Source: Holcim (Romania) SA's Sales Department statistics

The decision to use coal both in Alesd and in Campulung cement plants it is not done in order to get a competitive advantage but in order to be able to maintain the company current market share and moreover, as it can easily be seen, Holcim (Romania) is not the leader of the trend, but **only the follower**.

Political Factors

One of the important political factors that influences both baseline and project is Romania's willingness to join European Union.

At the country level that is resulting in efforts done both by government and authorities, but also by the industries in order to ensure a constant growth of the economy, a decrease in the inflation rate, important improvements of the infrastructures, which in turn will lead to an increase in the GDP per capita, in the purchasing power of the population, but also to a decrease of the unemployment rate.

Last but not least the Romanian society commitment for a steady positive development will lead to an increased attractiveness of the investment level and capital inflow into the country.

Yet, due to the relative political instability in Romania of the last 10 years, the business decisions (investment decisions) are taken based on very short pay back period (two to maximum five years) compared with the same decision taking process in the European Union.

Environmental Factors

Holcim (Romania) SA fully adheres at the Holcim Group commitment to the sustainable development: "Our commitment is to continuously improve our environmental performance and provide positive contributions to our business".

As one of the founders of World Business Council for Sustainable Development, Holcim is acting worldwide according with the same environmental principles:

Commitment to Sustainable Development

Holcim Environmental Principles

1 Management Systems	We apply environmental management guidelines and standards worldwide and monitor our performance.	We promote our commitment through training and integration into business processes.
2 Resources Utilisation	We promote eco-efficiency, conservation of non-renewable natural resources and recycling of secondary materials.	We invest in the development of innovative and sustainable products and processes.
3 Environmental Impacts	We measure our performance, continuously improve and promote best practice in our industry.	
4 Stakeholder Relations	We engage our stakeholders and report publicly on compliance, performance and progress.	

Holcim 1

Technical Factors

By the introduction of new "state of the art" and, in the same time, more ecologically friendly equipment the company will decrease the power consumption **both by decreasing the specific heat consumption** and **the specific electrical energy consumption.**

This may be the beginning of a new trend for the Romanian cement industry and therefore a support for the implementation of the international "Best Available Techniques" at the national level, resulting in further similar efforts for energy efficiency all over the industry.

By the introduction of new mineral components (MIC) , which are in the same time wastes of the other industries, otherwise landfilled, a multiple positive effect will be obtained:

- a decrease of the **clinker factor**, that is the amount of clinker used for each tone of cement (or **clinker content of cement**) and therefore a decrease the overall consumption (raw material, fuels, electrical energy etc) for producing the necessary clinker. Consequently, this will open a new trend for the Romanian cement industry supporting the alignment with the already existing international trend of obtaining high quality cements with lower clinker factors.

- a prevention of the non-usage penalties for the industries that are producing those wastes, by offering in the same time an environmentally friendly way for their elimination. This in turn can lead to a deeply involvement of the industry in solving the waste related problems existent at the national level. Such type of wastes are available in large quantities at the country level and presently landfilled.

• a development of new cement types already used in EU, creating a differentiation of cement types, increasing their quality and giving a positive impuls for the research in the field in order to create tailor-made products on customers demand (design cement) and contributing at the cement industry development at the national level

• an improvement of concrete performance due to special proprieties of the new mineral components used for the cement production: improved workability, reduced water demand, increased sulphate resistance (e.g. sea-water), prevents alcali-silica-reaction, reduces hydration heat, higher density, pozzolanic activity etc

5 IDENTIFICATION OF THE MOST LIKELY BASELINE AND THE ASSOCIATED GHG EMISSIONS

5.1. Identification of the most likely baseline

The following key factors have influence on both the specific and absolute CO2 emissions:

- specific heat consumption
- fuel specific CO2 emission
- specific electrical energy consumption
- electricity CO2 emission factor
- clinker content of cement (clinker factor)
- volume of cement produced

The influence of each of these factors is shown in the annexes B(1-4)A – for Alesd Cement Plant and B(1-4)B – for Campulung Cement plant, where detailed calculations are developed for each type of occurred CO_2 emissions

B1: The **most likely baseline** (B1A – for Alesd Cement Plant and B1B – for Campulung cement plant) for these projects is the continuation of current situation without a significant change to current efficiency of the plants, that means without any significant change in the specific electrical and thermal energy consumption per tone of cement.

In more detailed it means the continuation of the 2000 year status with only the change in the cement production volume requested by the market increase and the installation of new (cheaper) fuels (coal) feeding systems in order to decrease the production costs.

The clinker production is a process of heat production and consumption.
The heat produced by fuel burning is fully consumed in order to produce clinker (the chemical processes start at 900 Celsius degree and take place around 1450 Celsius degree

The **specific heat consumption** per tone of clinker may be slightly influenced by the losses through kiln and pre-heater tower refractory throughout the year, but do to the preventive maintenance done the variation is less than 1%.

Based on historical data[9] the specific heat consumption per tone of clinker taken into calculations is:

- 4.033 GJ/ tone of clinker produced in case of Alesd cement plant
- 3.921 GJ/ tone of clinker produced in case of Campulung cement plant

[9] Source: Plants' Annual Technical Reports for 2000

The **fuel specific emission** is calculated as an average of the specific emissions for each of the fuels used, taken into account the utilization percentage of each fuel.

The fuels utilization percentage is based on historical data from the same source[9].

At the company level, taken into consideration the trend of the market fuel price both on national and international level, but also the competitors actions, it was decided to introduce the usage of cheaper fuels (coal) as main type of fuel.

The assumed trend of types of fuel utilization can be seen in Annex B1A (Alesd cement plant) and in Annex B1B (Campulung cement plant).

The specific emission for fuels used are assimilated with the ones from Senter Guidelines for JI Projects[10]

Assumption: Heavy fuel oil ~ Residual Fuel Oil

Coal ~ Lignite (in order to be conservative)

The same assumption is used for the baselines scenarios and for the project

The **specific electrical energy consumption** is based on historical data from the same source. Without any improvement of the current delivery system (without the projects) a specific electrical consumption of:

- 144.71 kw/ t cement (for a clinker factor of 78) is taken into calculations for Alesd plant
- 132.34 kw/ t cement (for a clinker factor of 76) is taken into calculations for Campulung plant

The energy consumption is calculated for all the production phases (within the project boundaries).

For the **electricity CO_2 emission factor** are taken into account the data from "Baseline electricity grid CO_2 emission factors for JI projects reducing electricity consumption (in g CO_2 / kWh)" specific for Romania[11]

The **clinker content** of cement used for the calculation of the baseline is based on same historical data[9]. The used clinker factor is somehow low compared with the benchmarking for average clinker factor (variation between 80.6 and 81.9 for the years 1999-2001) in Holcim Central and Eastern Europe cement plants, due to different availability of the clinker substituting mineral components (MIC) at the countries levels. This lower level shows that there are great opportunities in Romania, where the availability of MIC is not a problem. Given the same availability of MIC in Romania, but without the project (research and investment), due to the technological limits of the process, cement with the same clinker factors as in the present would be also produced in Alesd and respectively in Campulung plants.

The **volume of cement production** is increasing yearly according with the market demand.

Usually small bumper stocks are used in the cement manufacturing process for raw meal, clinker and cement. The variation between beginning of year and end of year bumper stocks are insignificant, therefore for the simplicity sake all the bumper stock not taken into consideration. Therefore it is assumed to be produced only the volumes of clinker and raw materials necessary for the volume of cement produced.

For 2000 and 2001 the actual cement production volumes were taken into consideration.

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[10] Source: Senter Guidelines for JI projects Vol 1: Introduction, Chapter 6, Subchapter 6.1.

[11] Source: Senter Guidelines for JI projects – Vol 2 A, Annex B, table B2

For 2002-2006 the volumes of cement production assumed in the Company's Financial Plan were taken into consideration (average 3.5 % increase per year).

The step increase in the Alesd plant production volume for 2003 can be seen as an effect of the projects that will take place in Turda cement plant. In 2003, the Turda plant production capacity for grey cement is scheduled to be converted for the production of white cement. Therefore, in order to keep the market share the volume of grey cement production in Alesd will be increased correspondingly

For 2007 – 2012 the same 3.5 % production increase per year was assumed.

The assumed increasing trend is a conservative one, taken into consideration the trend forecasted by the Romanian Ministry of Industries and Resources Strategy, where for the industrial production an average 5.6 % increase per year is considered, and for the cement production an average 4% increase per year is considered, due to the same increase in the market demand.

Moreover, taking into account the current development of the cement market, which for 2002 shows an actual 7.2% increase, compared with the same period of 2001, the 3.5 % increase can be considered a conservative one.

It can be seen from the Annex B1A (Alesd) and B1B (Campulung), that for baselines B1A and respectively B1B, the relevant factors are the evolution of **electrical CO2 emission factor** and the **volume of produced cement,** excepting the trend of types of fuel utilization due to the cost reduction reasons, which produce a jump in the specific CO_2 emissions in the year 2003.

Without a significant change of the current delivery system, the specific energy consumption and the specific heat consumption remain unchanged.

In order to carry out a sensitivity analysis there were analyzed other possible baseline scenarios:

B2: The same assumptions as for the scenario of the most likely baseline B1, but with an increase of the production volumes with 4%/ year from 2007-2012, as forecasted by the Ministry of Industries and Resources in their "Construction Materials Development Strategy on middle and long term (2001-2010)". Their forecast was made based on the increase of the market demand driven by the increase in the income per capita, purchasing power of the population, investment level, the decrease of the unemployment rate, decreasing the inflation rate, the development of the infrastructure expected for the next years etc. The trend of the baseline is the same. There is the same specific emission per tone of cement, but due to the increased volume of production the total CO_2 emissions is higher (see Annex A2 for the calculation and emissions level). **There is a high possibility that this scenario will take place,** taking into account the current developments of Romanian economy and society.

B3: The same assumption as for the scenario of most likely baseline B1, but with an increase of the cement production volume only with 2 % from 2007- 2012, **which is considered too conservative and not very likely to happen** taken into account the current and expected future development**.** Seen in the international context, the cement production volume per capita is quite modest in Romania. With a consumption of 188 kg per capita in 2000 Romania is far from Poland, Czech Republic or Hungary having around 350 to 400 kg/c and even farther from European Union, where an average of 459 kg per capita was consumed in 1999[12]. In its ascension to European Union, Romania is expected to improve a lot also in this

[12] Source: Construction Materials Development Strategy on middle and long term (2001-2010) - Industry and Resources Ministry

field in order to reach a similar to EU development level (infrastructure, residential and non residential constructions etc)

There is the same specific emission per tone of cement, but due to the decrease volume of production the total CO_2 emissions is lower (see Annex B3A and B3B for the calculation and the corresponding emissions level).

B4: The same main assumptions as for the scenario of most likely baseline B1, but with an additional assumption regarding the fuel market: a simultaneous drastically decrease in heavy fuel oil price and increase in coal price so they will become equal, which will result in a change in their utilization (50% heavy fuel oil for Alesd, respectively 50% natural gas for Campulung and 50% coal – depending also of their availability). This scenario is **very unlikely to happen** taking into account the recent international market trend (Annex A)

There is a lower specific emission per tone of cement and consequently, a lower total CO_2 emissions (see Annex B4A and B4B for the calculation and the corresponding emissions level).

The detailed calculations of the on emissions for the analyzed baseline scenarios can be found:

- In Annex B1A and B1B for the most likely considered baseline B1 (for Alesd, respectively Campulung cement plant)
- In Annex B2A and B2B for baseline B2
- In Annex B3A and B3B for baseline B3
- In Annex B4A and B4B for baseline B4

Using the data from those annexes, Annexes BA and BB presents the trend of the specific CO_2 emission per tone of cement produced in Alesd cement plant, respectively Campulung cement plant (overlapping for B1, B2, B3) and the trend of annual absolute (total) CO_2 emission resulted from the cement production process in the respective plants. From the charts of Annexes CA and CB it results that even if the specific CO2 emission per tone of cement produced has a decreasing evolution for all the baselines, due to the increasing amount of produced cement the total amount of CO2 emission is increasing in each case.

5.2. Baseline selection, specification and calculation of the associated emissions

Since only the clinker factor, the cement production volume and the fuel utilization are representative for the future CO2 evolution in case of continuation of current situation, we are assessing the baseline taking in account the evolution of these factors.

The most likely baseline scenario is in the baseline B1 case which is designed in a conservative manner based on:

- historical data and group benchmarking for Central and Eastern Europe (clinker factor),
- the already decided at the company level (due to the cost reduction reasons) trend of types of fuel utilization,
- cement market increasing trend
- technical characteristics of the process in case of no investments and historical data (specific heat and specific electrical energy consumption)

Annexes B1A and B1B are showing all the key factors development and also the calculation of the related emissions in case of Alesd and respectively Campulung cement plant.

On-site emissions

- **CO_2 emission from raw material calcinations**

The default factor of 525 kg CO_2/t of clinker produced (Calcination CO2) recommended by the Cement CO_2 Protocol is used throughout the years for calculations simplification for both plants cases, due to the chemistry of the clinker production process (row 2).

A more exact calculation can be done for the calcinations CO_2 for both plants, by using the CaO and MgO content of clinker from historical data[13].

$$\mathbf{CaCO_3 + heat \rightarrow \underset{56}{\overset{1t}{CaO}} + \underset{44}{\overset{x}{CO_2}}}$$

$$\mathbf{Mg\,CO_3 + heat \rightarrow \underset{40}{\overset{1t}{MgO}} + \underset{44}{\overset{y}{CO_2}}}$$

x = 44/56 = 0.785 kg CO_2 are released for each kg of CaO from clinker

y = 44/40 = 1.1 kg CO_2 are released for each kg of MgO from clinker

Actual factor = % CaO from clinker * 0.785 + % MgO from clinker * 1.1

For the year 2000, **in case of Alesd plant**:
% CaO from clinker = 65.55 %
% Mg O from clinker = 1.45 %
Actual factor for Alesd = 0.6555*0.785+0.0145 *1.1 = 0.514+0.016= 0.530 kg CO_2/ kg clinker =
= 530 kg CO_2 / t clinker

For the year 2000, **in case of Campulung plant:**
% CaO from clinker = 64.38 %
% MgO from clinker = 1.41 %
Actual factor for Campulung = 0.6438*0.785+0.0141 *1.1 = 0.521 Kg CO_2/ kg clinker =
= 521 kg CO_2 /t clinker

The CaO and MgO content of clinker slightly varies from year to year and from plant to plant in the cement industry, around 65% of CaO and 1.45 % of MgO, but due to the fact that this variations are resulting in a variation of less than 1% of the actual calcinations factor, the recommended default factor of 525 kg CO_2 /t clinker is taken into calculations for baseline, projects and also monitoring and reporting purpose.

As it can also easily be seen, the absolute CO_2 emission from raw material calcinations (row 3) is increasing in time due to the increasing volume of clinker production. (row 1)

[13] Source: Plants' Annual Technical Reports for 2000

The volume of clinker production is calculated by multiplication of the cement production volume with the clinker factor.

- **CO_2 emission from fuel burning**

The specific CO_2 emission from fuel burning is obtained by multiplying the specific heat consumption with an average fuel specific CO_2 emission. (row6)
The average fuel specific CO_2 emission is calculated by a weighted average of the used fuels specific CO_2 emission.
One can easily notify an increase when the change for coal takes place.

Further on, the absolute CO_2 emission from fuel burning is calculated by multiplication of the specific one with the produced clinker volume (row 7)

- **Total (absolute) direct on-site emissions** figures are calculated by addition (row 8)

Total direct on-site emissions during the credit period = Σ (Yearly Absolute direct on-site emissions).

From *Annex B1A* it results a total amount of **3,604,724** t CO2 from on site emissions during 2008 – 2012 for Alesd cement plant

From *Annex B1B* it results a total amount of **2,680,280** t CO2 from on site emissions during 2008 – 2012 for Campulung cement plant.

*For both plants it results a total amount of **6,285,004** t CO2 from on site emissions during 2008 – 2012*

Direct Off-site emissions

From the row 11 of the Annex B1A and B2B, it results that the specific CO2 emission resulted from the electrical energy consumption is decreasing during the time, due to the gCO2/kWh factor decresing.
Baseline absolute off-site emissions figures are calculated by multiplication of the related specific emissions per tone of cement with the cement production volume (row12)

Total direct off-site emissions during the credit period = Σ (Yearly Absolute direct off-site emissions).

From *Annex B1A* it results a total amount of **459,496 t CO2** from off site emissions during 2008 – 2012 for Alesd cement plant

From *Annex B1B* it results a total amount of **330,171 t CO2** from off site emissions during 2008 – 2012 for Campulung cement plant

*For both plants it results a total amount of **789,667 t CO2** from off site emissions during 2008 – 2012*

Total baseline CO2 emissions

total baseline CO2 emissions = Baseline on-site emissions + Baseline off-site emissions

Total baseline CO2 emissions figures are given in Annex B1A and B1B

From *Annex B1A* it results a total amount of **4,064,220 t CO2** from total emissions during 2008 – 2012 for Alesd cement plant

From *Annex B1B* it results a total amount of **3,010,451 t CO2** from total emissions during 2008 – 2012 for Campulung cement plant

*For the period 2008 – 2012, for both Alesd and Campulung plants, it results a total amount of **7,074,671 t** CO2 for the total emissions, in the case of most likely baseline*

6 ESTIMATION OF PROJECT EMISSIONS

6.1. Description of factors used for estimation of project emissions

The following key factors have influence on both the specific and absolute CO2 emissions:

- specific heat consumption
- fuel specific CO2 emission
- specific electrical energy consumption
- electricity CO2 emission factor
- clinker content of cement (clinker factor)
- volume of cement produced

The influence of each of these factors is similar with their influence over the baseline emissions

A. Alesd Cement Plant

The project **Upgrading Alesd II cement plant** is bringing significant improvements in the phase of raw meal preparation, clinker production, clinker (cement) grinding (cement mill), where both energy (thermal and electrical) consumption improvement and addition of the mineral components in order to reduce the clinker content per tone of cement are taking place.

A summary of the project activities that are affecting the **specific heat consumption** and the **specific electrical energy consumption** and also the calculations for these two key factors can be found in Annex E (Summary + Annexes 1-5)

The **specific heat consumption** per tone of clinker is an important factor in the clinker production phase. From Annex E one can see that for the newly upgraded plant the specific heat consumption is estimated to be 3600 KJ/Kg of clinker, but for the year of re-commissioning of the cement plant a specific heat consumption of 3,800 kJ/kg clinker shall be assumed.

The **fuel specific emission** is an important factor for the clinker production phase, calculated as an average of the specific emissions for each of the fuels used, taken into account the same utilization percentage of each fuel assumed in the case of baseline. The utilization percentage of each fuel is not influenced by the project.

The **specific electrical energy consumption** is a factor that has importance for each phase of the production process. Assumption were made for coal grinding and new mineral component handling specific energy consumption.

The specific energy consumption for each phase is calculated by division of the total absorbed power at the assumed capacity.

For the first stage, when all the priority 1 subprojects are finished (2004), a specific electrical energy consumption of **108,5 kWh/t cement** at a **clinker factor of 0,70** is assumed. For a conservative approach a **110 kWh/t cement** at a **clinker factor of 0,70** is taken into calculations.

In the second stage, when also the priority 2 subprojects are finished, a specific electrical energy consumption **103,0 kWh/t cement for a clinker factor of 0,70.** For a conservative approach a **105 kWh/t cement** at a **clinker factor of 0,70** is taken into calculations.

In the first year of recommissionning (2003) of the Alesd II Plant a somewhat higher specific energy consumption of **118,0 to 120,0 kWh/t cement** shall be assumed. For a conservative approach a total specific energy consumption of 120 kwh/t cement is taken into calculations.

For the **electricity CO_2 emission factor** are taken into account the data from "Baseline electricity grid CO_2 emission factors for JI projects reducing electricity consumption (in g CO_2 / kWh)" specific for Romania[14]

Due to the project, which also include introduction of a new mineral component and development of new types of cement, the **clinker content** of cement is decreased. The target assumed in the Company Business Plan is 60% up to 2006, given the availability of MICs in Romania, resulted from the studies conducted by Holcim's specialists and also the results obtained by the group in countries with similar MIC availability.[15] A conservative clinker content (clinker factor) of 70 % is taken in the calculation of the project expected CO_2 emissions.

The **volume of cement production** is the same with the one assumed in the case of baseline B1A, due to the fact that the production volume it is not influenced by the project

B. Campulung Cement Plant

The project **Refurbishment of Campulung Cement Plant** is bringing significant improvements in the phase of clinker (cement) grinding (cement mill) where both energy consumption improvement and addition of the mineral components in order to reduce the clinker content per tone of cement are taking place.

The **specific heat consumption** per tone of clinker is an important factor in the clinker production phase and so its value it is not influenced by the project. As in the case of baseline, it may also be slightly influenced by the losses through kiln and pre-heater tower coatings, kiln input and output seals, but do to the preventive maintenance done the variation is less than 1%.

[14] Source: Senter Guidelines for JI projects – Vol 2 A, Annex B, table B2
[15] Banska Bystrica (Slovak Republic) – 64%, Koromacno (Croatia) – 66%

Based on historical data[16] a specific heat consumption of 3.921 GJ/ tone of clinker produced is taken into calculation.

The same it can be said about the **fuel specific emission.** It is an important factor for the clinker production phase, calculated as an average of the specific emissions for each of the fuels used, taken into account the same utilization percentage of each fuel assumed in the case of baseline. The percentage of each fuel utilization is also not influenced by the project.

The **specific electrical energy consumption** is a factor that has importance for each phase of the production process so the improvement activities in the clinker (cement) grinding phase will also influence this factor. The main improvement activities are:

- installation of new gear box for the cement mill 5
- installation of a high efficiency separator for cement mill 5 with variable speed drive
- installation of a separator fan with variable speed for cement mill 5
- related installations: new material feeding equipment (new weighfeeders, conveyors, modification of existing concrete feed bins)
- new mineral component unloading, storage, handling and dosing systems

From Annex F shows the total energy consumption of the upgraded cement mill clinker (cement) grinding is calculated. The specific energy consumption for this phase is calculated by division of the total absorbed power at the assumed cement mill capacity.

Annex G shows the total specific energy consumption for all the phases (within the project boundary), all the other phases specific energy consumption remaining unchanged. Their values are based on historical data[17]. Assumption were made for coal grinding and new mineral component handling specific energy consumption.
For a conservative approach a total specific energy consumption of **120 kwh/t cement** is considered.

For the **electricity CO_2 emission factor** are taken into account the data from "Baseline electricity grid CO_2 emission factors for JI projects reducing electricity consumption (in g CO_2 / kWh)" specific for Romania[18]

Due to the project, which also include introduction of a new mineral component and development of new types of cement, the **clinker content** of cement is decreased. The target assumed in the Company Business Plan is 60% up to 2006, given the availability of MICs in Romania, resulted from the studies conducted by Holcim's specialists and also the results obtained by the group in countries with similar MIC availability. A conservative clinker content (clinker factor) of 70 % is taken in the calculation of the project expected CO_2 emissions.

The **volume of cement production** is the same with the one assumed in the case of most likely baseline B1B, due to the fact that the production volume it is not influenced by the project

[16] Source: Campulung Annual Technical Report 2000
[17] Source: Campulung Annual Technical Report 2000
[18] Source: Senter Guidelines for JI projects – Vol 2 A, Annex B, table B2

6.2. Calculation of direct project emissions

Annexes DA and DB show all the key factors development and also the calculation of the related emissions

Direct on-site emissions

- **CO_2 emission from raw material calcinations**

The same default factor of 525 kg CO_2/t of clinker produced is used throughout the years, due to the chemistry of the clinker production process and for the sake of simplicity (row 2).

Still the absolute CO_2 emission from raw material calcinations (row 3) is increasing in time due to the increasing volume of clinker production. (row 1)

The volume of clinker production is calculated by multiplication of the cement production volume with the clinker factor. Due to the decrease in the clinker factor the volume of clinker production will be lower than in the case of baseline.

- **CO_2 emission from fuel burning**

The specific CO_2 emission from fuel burning is obtained by multiplying the **specific heat consumption** with an average fuel specific CO_2 emission. (row6)

The average fuel specific CO_2 emission is calculated by a weighted average of the used fuels specific CO_2 emission.

One can easily notify an increase when the change for coal takes place.

Further on the absolute CO_2 emission from fuel burning is calculated by multiplication of the specific one with the lower produced clinker volume (row 7)

- **Total (absolute) direct on-site emissions** figures are calculated by addition (row 8)

Total direct on-site emissions during the credit period = Σ (Yearly Absolute direct on-site emissions).

From *Annex DA* it results a total amount of **3,074,090** t CO2 from the direct on site emissions during 2008 – 2012 for Alesd cement plant

From *Annex DB* it results a total amount of **2,479,445** t CO2 from the direct on site emissions during 2008 – 2012 for Campulung cement plant.

*For the portfolio of the projects in both plants it results a total amount of **5,553,535** t CO2 from the direct on site emissions during 2008 – 2012*

Direct off-site emissions

From the row 11 of the Annex DA and DB it results that the specific CO2 emission resulted from the electrical energy consumption is decreasing during the time, due to the g CO2/kWh factor decreasing.

Project absolute off-site emissions figures are calculated by multiplication of the related specific emissions per tone of cement with the cement production volume (row12).

Total direct off-site emissions during the credit period = Σ (Yearly Absolute direct off-site emissions).

From *Annex DA* it results a total amount of **333,406** t CO2 from the direct on site emissions during 2008 – 2012 for Alesd cement plant

From *Annex DB* it results a total amount of **299,385** t CO2 from the direct on site emissions during 2008 – 2012 for Campulung cement plant.

*For portfolio of the projects in both plants it results a total amount of **632,791** t CO2 from the direct on site emissions during 2008 – 2012*

6.3. Calculation of indirect project emission effects (leakage)

Indirect on-site emissions

Emissions produced by the transport by road/rail of fuels, raw materials (including MIC) and cement are not considered for both baseline and project emission calculation, due to the relative insignificance and uncertainty of the emission quantification process. As a project leakage only the transportation of supplementary quantity of new MIC added into the cement production.

The next calculation is performed in order to show the relative insignificance of the emissions resulted for this transportation, assuming:

- an average distance of 100 km (one way)
- an average 18 tones per truck loading capacity
- an average fuel consumption of 40 liters of diesel oil /100 km
- a utilization of 15% new MIC into the cement
- diesel oil density ~ 0.9 kg/l
- diesel oil calorific value ~ 40,000 kJ/Kg = 40 GJ/t diesel oil

Per truck Fuel consumption for a return trip (two ways) = 2*40*0.9 (density) = 72 kg diesel oil

18 tones new MIC …………………0.072 t diesel oil
1 tone……………………………….x

$x = 4 * 10^{-3}$ t diesel oil/ t of new MIC

Diesel oil CO_2 default emission factor = 74.1 kg CO_2 / GJ[19]

Transportation CO_2 / t new MIC = $4 * 10^{-3}$ t diesel / t new MIC * 40 GJ/ t diesel oil *7 4.1 kg CO_2 / GJ = 11.856 Kg CO_2/ t new MIC

Transportation New MIC CO_2 / t cement = 11.856 * 0.15 ~1.8 Kg CO_2 supplementary emission per tone of cement

Comparing with 700 kg/ t of cement – specific emissions for cement production (see Annexes DA,DB,etc), the additional emissions due to the transport of New Mic per tone of cement produces is approximately 0.25 %, therefore insignificant.

[19] Source: IPCC

Indirect off-site emissions

Emissions due to shifts in demand and/or supply of electricity and in demand and/or supply of different types of fuels will not be taken into account in the quantification of emissions, as they are difficult to measure and are not within the control of the project developer.

6.4. Calculation of total project emissions

total portfolio of projects CO_2 emissions

total portfolio CO_2 emissions = Portfolio on-site emissions + Portfolio off-site emissions

For the period 2008 – 2012, it results a total amount of **6,186,326 t CO_2** from total portfolio of project emissions

7 CREDITING TIME

Start date of the projects	2000
Life time of the project	Minimum 10 years from projects start up
Crediting time of the project (only relevant if the project crediting time will end before 2012)	-

8 ESTIMATION OF EMISSION REDUCTION

The estimation of the emission reduction due to the project portfolio can be tackles in two ways.

A first approach is by subtracting from the Baseline total absolute emissions the Project total absolute emissions.

total CO2 emissions reduction = Baseline total emissions - Project total emissions

The evolutions of total absolute CO2 emissions in the case of most likely baselines and in the case of projects are shown in Annex H1.

For the period 2008 – 2012, this means:

7,074,671 – 6,186,326 = 888,345 t CO2

equivalent with:

888,345 ERU

A second approach is proposed by Holcim (Romania) SA for a better understanding of the way the green house gases reductions are obtained.

Due to the fact that the Project results in an increase of energy efficiency, both thermal and electrical, which in change results in a decrease of specific CO_2 emissions per tone of cement produced, this second approach estimates first the reductions to be obtained in the specific CO_2 emissions per tone of cement for each plant, and then by multiplication with the assumed production volume for the plants, the absolute emission reductions are obtained for each project.

By addition, the total absolute CO2 emissions reductions for the whole portfolio is calculated (see annex H2 for detailed calculations)

One can easily notice that by both approaches it is estimated the same CO_2 emission reduction.

The second approach is a much more proper way for estimating the reductions of emissions due to the Project because it better underlines the real benefits of the project – **reduction of specific CO_2 emissions per tone of cement.**

Moreover, it is a much more proper way for monitoring and reporting the emissions reductions because it allows that the actual production volumes to be used in the calculations in order to obtain the real absolute CO_2 reductions obtained due to the project implementation.

Therefore, the established **Baseline will be fixed from the point of view of the specific CO_2 emissions per tone of cement**, and the monitoring of the emission reductions will be based on the determination of the emission reductions per tone of cement produced, which will be multiplied by the actual annual production to get the **total annual emission reductions in the project period**.

By using the actual production volumes, this approach also diminishes the effects, which an eventual **unpredictable** variation of the market demand might have over the CO_2 emission reduction and it allows the sustainable development of the company in an environment with an increasing market demand.

For a more conservative approach, the reduction of the absolute CO_2 emissions due to the proposed portfolio of Projects is estimated at the 800,000 t of CO_2 for 2008-2012.

Early CO_2 emissions reductions are also estimated to take place as result of this JI Project.

Keeping the same conservative approach, the estimated amount is 500,000 t of CO_2 for 2004-2007. This reduction is also offered for transfer between countries, as early credits.